

STUDIES ON GLUCOSE-6-PHOSPHATE DEHYDROGENASE OF ADRENAL TISSUE

BY
THOMAS LAWRENCE KELLY
B. S., Purdue University, 1950



AN ABSTRACT OF A THESIS
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN CHEMISTRY
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1953

URBANA, ILLINOIS

1953

STUDIES ON GLUCOSE-6-PHOSPHATE
DEHYDROGENASE OF ADRENAL TISSUE

BY

THOMAS LAWRENCE KELLY

B. S., Purdue University, 1950

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN CHEMISTRY
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1953

URBANA, ILLINOIS

1953

ACKNOWLEDGMENT

The author wishes to express his appreciation to Dr. Carl S. Vestling for his interest, advice, and encouragement which were given so readily throughout the course of the author's studies.

He is also indebted to Parke, Davis and Company for the research fellowship which he held from September, 1951, to August, 1953.

STUDIES ON GLUCOSE-6-PHOSPHATE DEHYDROGENASE OF ADRENAL TISSUE

INTRODUCTION

Glucose-6-phosphate dehydrogenase is the enzyme which catalyzes the direct oxidation of glucose-6-phosphate to 6-phosphogluconic acid. This oxidation, which requires triphosphopyridine nucleotide (TPN) as a coenzyme, is the first of a series of reactions known as the hexosemonophosphate shunt. The direct oxidation of glucose-6-phosphate was first recognized by Warburg and Christian, in 1931, in hemolyzates of human erythrocytes (1). Since that time it has been observed in a variety of tissues from both animal and plant sources. The first indication of its importance in adrenal tissue was the result of studies on the respiration of homogenates of guinea pig adrenals (2).

A detailed study of glucose-6-phosphate dehydrogenase of adrenal tissue was undertaken to expand the knowledge concerning the basic metabolic patterns of adrenal tissue. It was hoped that general information could be gained about the other reactions of the hexosemonophosphate shunt and that some explanation might be found for the particular importance of this pathway in adrenal metabolism.

DISCUSSION OF RESULTS

Manometric experiments were carried out to show that TPN greatly enhances the respiration of beef adrenal homogenates when glucose-6-phosphate is used as the substrate. Aqueous extracts of adrenal tissue were prepared which were highly active in reducing TPN in the presence of glucose-6-phosphate, as determined spectrophotometrically, but which were completely inactive toward diphosphopyridine nucleotide (DPN). These aqueous extracts of adrenal tissue showed much greater glucose-6-phosphate dehydrogenase activity than did extracts prepared in an identical manner from beef kidney, liver, heart, spleen, and skeletal muscle.

A partial fractionation of the adrenal extract was ac-

complished with the use of ammonium sulfate precipitation. The purpose of the fractionation was to remove 6-phosphogluconic dehydrogenase so as to have a preparation suitable for equilibrium measurements. An equilibrium constant for the reaction between glucose-6-phosphate and TPN at pH 7.4 was obtained. The average value for the constant was 22.8, which represented a reduction of the TPN to the extent of eighty-two per cent, starting with equimolar amounts of the two substrates.

Preliminary experiments on pentose metabolism indicated that adrenal tissue is capable of converting ribose-5-phosphate to glucose-6-phosphate. The cysteine-carbazole reaction of Dische and Borenfreund (3) was used to detect possible intermediates in this conversion.

BIBLIOGRAPHY

1. Warburg, O., and Christian, W., *Biochem Z.*, **242**, 206 (1931).
2. Nielson, E. D., Thesis, Doctor of Philosophy, University of Illinois, 1948.
3. Dische, Z., and Borenfreund, E., *J. Biol. Chem.*, **192**, 583 (1951).

VITA

The author was born on January 22, 1926, in Terre Haute, Indiana. He graduated from Wiley High School in Terre Haute, in 1943, and served in the Army of the United States from 1944 to 1946. Upon discharge from the Army he entered Purdue University from which he received the degree of Bachelor of Science in June, 1950. He entered the Graduate College of the University of Illinois in September, 1950, and held a Parke, Davis Research Fellowship from September, 1951, to August, 1953. The author and Patricia Welch were married in May, 1947, and they now have two children.

